

# Quabbin Reservation White-Tailed Deer Impact Management Program: 5-Year (2000-2004) Review and New 5-Year Plan (2005-2009)



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Division of Water Supply Protection  
Natural Resources Section  
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## **I. BACKGROUND**

In 1991 Quabbin Reservation was opened to limited, controlled public deer hunting after 50 years without hunting. This action was in response to growing concern about the impacts of deer browsing on forest regeneration and the potential long-term consequences of those impacts on water quality. Hunting has been conducted on the reservation each year since.

The controlled hunts constituted only one component of a comprehensive 1991 White-tailed Deer Impact Management Plan for the reservation that also included the use of electrified fencing and various changes in the Department of Conservation and Recreation, Division of Water Supply Protection's (Division) (formerly the Metropolitan District Commission, Division of Watershed Management) land management program. That plan called for six years of controlled hunting, followed by a major review and re-evaluation of the program. That review was conducted in the spring of 1997 when two reports (**Quabbin Regeneration: Summary Report 1988-97** and **Quabbin Reservation White-tailed Deer Impact Management Program: Results and Evaluation 1991-1996**) were issued by the Division. Also at that time, recommendations for the next phase of the program were issued in the document **Quabbin Reservation White-tailed Deer Impact Management Program: Summary Report and Proposal 1997**. Those recommendations called for a continuation of the controlled hunting program with several changes proposed to make the program more efficient.

The driving force behind the deer reduction program has always been to reduce the impacts of deer browsing to a level that allows and promotes the development of a healthy, resilient, diverse forest that can adequately and continuously protect water quality. Major components of the deer population reduction program were to 1.) Reduce population densities and 2.) Maintain those densities at a level that allows for the continued growth and regeneration of forest tree species.

After several years of controlled hunts, substantial reductions in deer population densities were achieved in all hunt areas, and the Division has been in the maintenance phase of its program for several years. The maintenance phase of the program is essential for maintaining relatively stable deer population levels and eliminating potentially large swings in deer densities that could occur if hunting were stopped for an extended period of time. In the absence of regular hunting mortality, deer populations at lower densities that have little natural mortality and an increasing food supply would expand and could jeopardize the forest regeneration progress made to date. In 2000, a five-year plan was developed that outlined proposed activities for the next five years. This report summarizes results from the 5-year plan and outlines the programs goals and plans for the next five years (2005-2009).

## II. 2004 PROGRAM RESULTS

### A. Hunter Effort and Participation

Participants in the hunts are chosen in a random lottery from a pool of licensed hunters submitting the required application form and fee. The number of hunters applying for the hunt has varied from approximately 1,050 in 2001 to over 9,500 in 1992 (Table 1). The number of hunters chosen in any one year has varied, depending on the number of areas being hunted and the number of hunting segments per area. The number of hunters applying to the Quabbin hunts has dropped sharply since 1991. The number of applications received in 2004 was the highest since 1998, and while these numbers are encouraging, it is difficult to predict how many applications will be received next year. It is impossible to predict future trends in hunter interest, although statewide and regional trends would indicate that the hunter base and hunter recruitment is continuing to diminish. Fortunately, the number of hunters being selected has remained relatively stable since 1995 when the Division began to shift towards the maintenance phase of its program in some management blocks. Further, since 2000 only 4 of the 5 blocks are hunted annually, and fewer hunters are needed to maintain the same hunter densities.

Table 1. Number of hunters applying and selected for Quabbin deer hunts, 1991-2004.

YEAR	# HUNTERS		PERCENT ACCEPTED
	APPLYING	SELECTED	
1991	7444	1020	14
1992	9503	2089	22
1993	7052	2303	33
1994	3418	2348	69
1995	4846	1702	35
1996	2742	1503	55
1997	1790	1525	85
1998	2086	1338	64
1999	1522	1311	86
2000	1143	1020	89
2001	1057	1042	99
2002	1416	1236	87
2003	1664	1167	70
2004	2017	1484	74

Hunters who had attended at least one orientation session in the past 6 years were exempt from attending a session in 2004. At the orientation, a video featuring Division rangers presented the reasons for the hunt, safety considerations, rules and

regulations, sanitary concerns, procedures and related topics. Each hunter was required to purchase an antlerless permit from MassWildlife and assigned a specific hunt area and hunting segment. All hunters were assigned to specific access gates and required to check in and out each day, thereby effecting greater control over hunter distribution.

Following the revised outline of the 5-year deer management plan (see **Quabbin Reservation 5-year White-Tailed Deer Impact Management Program, 2003**), New Salem was excluded from hunting during 2004. The other four blocks (Pelham, Hardwick, Prescott, and Petersham) were each hunted for two days.

### ***Bonus Antlerless Permits***

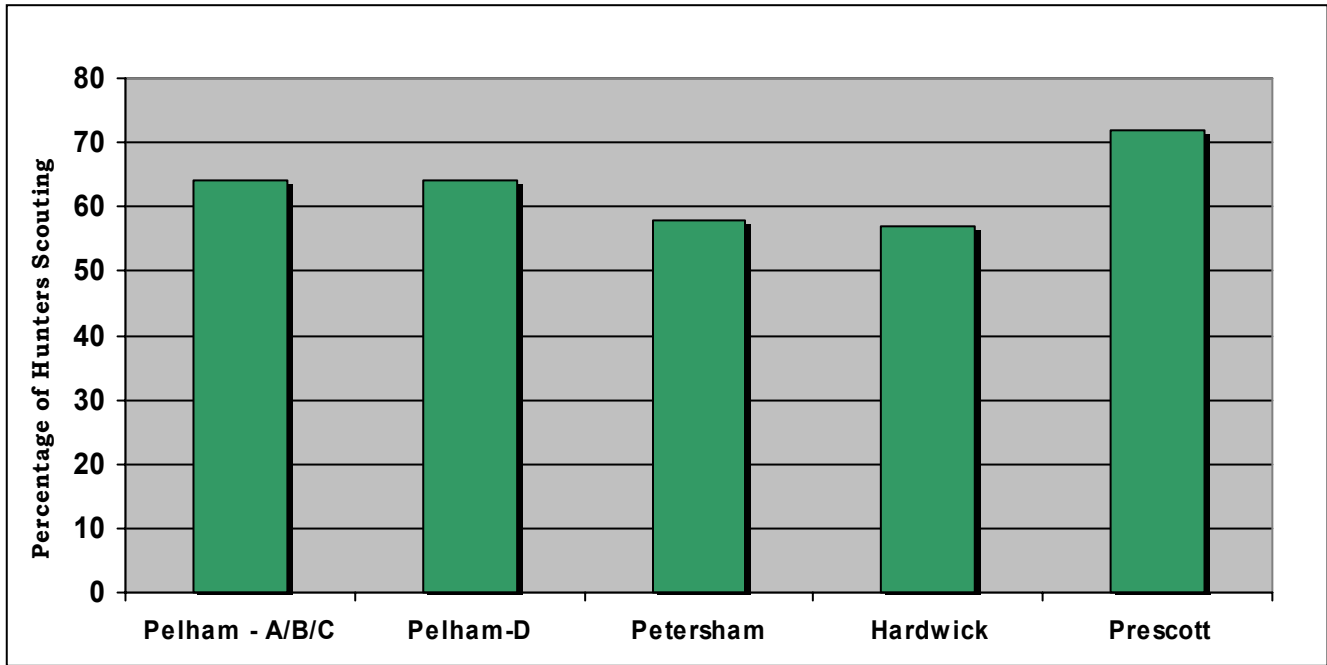
As discussed in the 2001 report, **Quabbin Reservation 5-year (2000-2004) White-Tailed Deer Impact Management Program: Program Status and Results from 2001**, the Division successfully lobbied MassWildlife to exempt antlerless deer killed at Quabbin from the statewide bag limit. All Quabbin hunters are required to purchase at least one antlerless permit prior to hunting. In response to hunter requests, extra antlerless permits (in addition to the 1 required) were made available for purchase during the orientation sessions and through the mail for hunters exempt from orientation. Hunters were allowed to purchase 1 extra antlerless permit for a total of 2 Quabbin specific antlerless permits.

### ***Scouting***

The Division has always allowed eligible hunters to access the hunt areas by foot (except Prescott), and in some areas by bicycle, for scouting prior to the hunt. However, efficient and thorough scouting is difficult because many of the hunt areas are large or restricted (Prescott). Six years ago the Division modified the hunt program to allow vehicle access for scouting hunters. In 1999, the Division allowed 1 day of car scouting for Prescott hunters only. In 2000, the program was expanded to allow 1 day vehicle scouting for all the hunted blocks. Since 2001, the program has allowed 2 consecutive days of vehicle scouting for all hunting blocks. In 2003, scouting times were shortened by a few hours in order to conserve resources. In addition, data from previous years of scouting indicated that most hunters who scouted were only in the field for a maximum of 3 hours. Reducing the scouting hours did not appear to affect the level of participation. The participation rate for scouting prior to the 2004 hunt ranged from 57 percent to approximately 72 percent (Fig. 1).

The verbal feedback from hunters about scouting has been overwhelmingly positive. Hunters are able to efficiently scout larger areas and cover more territory. Further, car scouting allows Prescott hunters the only opportunity to visit the hunt area prior to the hunt. Car scouting will be allowed prior to the 2005 hunt in all hunting blocks.

Figure 1. Vehicle scouting participation rates for the 2004 Quabbin deer hunt.



## B. Harvest Results

In 2004, 167 deer were killed (Table 2). This represents the second highest deer kill since 1997. Harvests were down in both Petersham and Hardwick. Harvest was slightly up in Pelham and increased substantially in Prescott.

The percentage of females in the 2004 harvest was comparable to the long-term average for the Quabbin hunts. The percentage of antlerless deer (females + male fawns) was slightly less than the long-term average.

Table 2. Results of controlled deer hunt on Quabbin Reservation, by year, 1991-2004.

YEAR	TOTAL DEER	% FEMALE	% MALE	% A/L <sup>1</sup>	DEER/ Mi <sup>2</sup> (killed)	# HUNTERS	HUNTER SUCCESS <sup>2</sup>	Mi <sup>2</sup> HUNTED
1991	575	60.3	39.7	71.8	40.9	855	67.3	14.1
1992	724	54.0	46.0	60.5	21.7	1971	36.7	33.4
1993	474	62.0	38.0	67.1	9.5	2168	21.9	49.7
1994	673	59.9	40.1	68.9	10.7	2118	31.6	63.1
1995	284	64.8	35.2	74.3	4.7	1508	18.8	60.9
1996	129	58.1	41.9	67.4	2.0	1213	10.6	63.1
1997	293	62.1	37.9	73.4	4.8	1207	24.3	63.1

Table 2. Continued

YEAR	TOTAL DEER	% FEMALE	% MALE	% A/L <sup>1</sup>	DEER/ Mi <sup>2</sup> (killed)	# HUNTERS	HUNTER SUCCESS <sup>2</sup>	Mi <sup>2</sup> HUNTED
1998	123	57.7	42.3	65.9	2.3	1099	11.2	55.8
1999	112	39.3	60.7	51.8	1.8	1192	9.4	63.1
2000	106	47.2	52.8	55.7	1.7	818	13.0	49.1
2001	101	51.5	48.5	58.4	1.9	855	11.8	52.0
2002	153	48.4	51.6	64.1	3.0	967	15.8	50.2
2003	306	69.0	31.0	83.7	6.9	938	32.6	44.2
2004	167	47.9	52.1	58.7	3.0	1259	13.3	55.8
Overall	4220	avg=55.9	avg=44.1	avg=66.8	-	18168	avg= 22.7	-

<sup>1</sup> A/L: antlerless; females and young males with antlers less than 3 inches long.

<sup>2</sup> Hunter success is the number of deer taken per 100 hunters. Some hunters took more than one deer, so these figures slightly overestimate the proportion of successful hunters.

### C. Hunting Block Summaries

#### *Pelham*

Thirty deer were killed in 2 days of hunting in Pelham (Table 3). Approximately 9% of the hunters in Pelham successfully killed a deer. Females accounted for 50% of the harvest, which is a slightly above the long-term average. Hunter densities were slightly higher in 2004. There was approximately 1 hunter per 27 acres.

Table 3. Results of Quabbin Reservation controlled deer hunt, Pelham Block, 1991-2004.

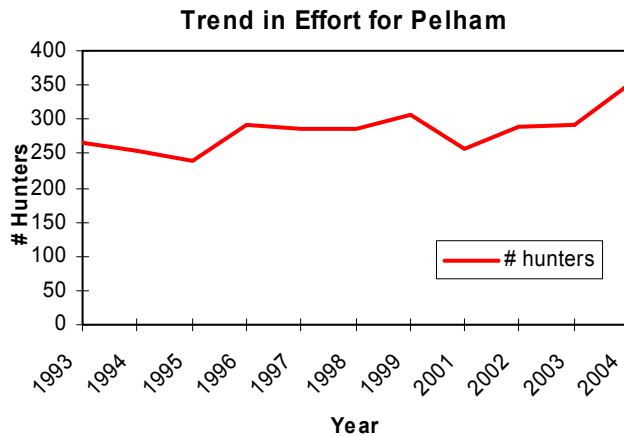
YEAR	# DEER KILLED	DEER/MI <sup>2A</sup>	DEER/HUNTER	% FEMALE	# ACRES/HUNTER
1991	575	40.9	.67	60.3	31
1992	111	7.9	.12	56.8	30
1993	58	4.1	.22	56.9	34
1994	50	3.6	.20	46.0	36
1995	28	2.4	.12	42.9	32
1996	15	1.1	.05	66.7	32
1997	48	4.0	.17	56.3	31
1998	22	1.9	.08	68.2	31
1999	20	1.7	.07	45.0	30
2000	N/A <sup>B</sup>	-	-	-	-
2001	35	2.9	.14	48.6	30
2002	59	4.1	.20	45.8	32
2003	24	1.6	.08	50.0	32
2004	30	2.1	.09	50.0	27
Total	1075		Avg. =0.2	Avg.=53.3	Avg.=31.4

<sup>A</sup> Represents the number of deer killed per square mile; <sup>B</sup> Area was not hunted during that year.



## 1. SUSTAINED YIELD THEORY

Sustained yield theory (SYT) is used often in practical wildlife management. In essence, SYT uses population dynamics to generate a productivity curve. If adequate and accurate data exists on reproduction, mortality, etc. then studying the curve and the parameters used to generate it, can result in estimates of carrying capacity, maximum sustained yield, and preferred population densities (for a detailed discussion on SYT, see **Quabbin Reservation: White-Tailed Deer Impact Management Program, Results of 1998 Program and Recommendations for 1999 Program**). At Quabbin, as in most cases, the detailed information on reproduction, mortality, etc. does not exist. However, harvest statistics were used to assess the herd statistics relative to the sustained yield curve. Yearly hunter harvest, hunter effort, and an index of annual relative abundance were plotted through time to examine trends in these parameters

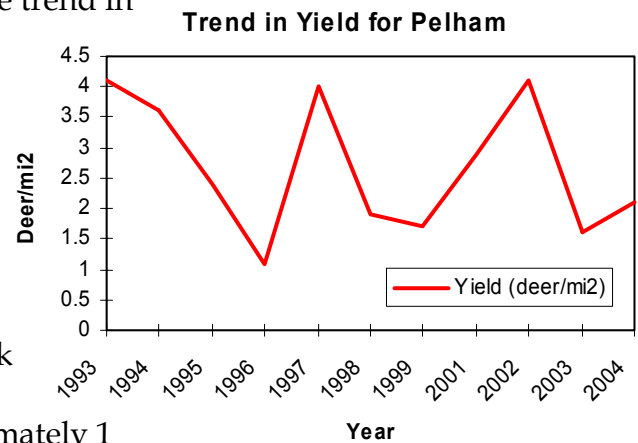
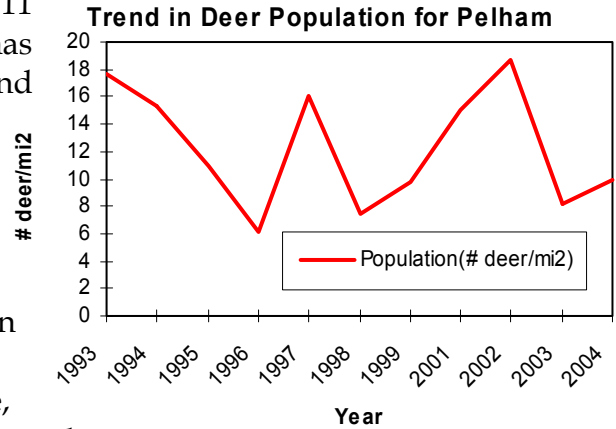


Yearly harvest was easily obtained and is represented as #deer killed/mi<sup>2</sup>. Hunter effort was expressed as the total number of hunters in each hunting block. To estimate relative abundance, several population estimates were made using the buck:population ratio and harvest:population ratio. The buck:population ratio assumes that the number of bucks killed each year is a percentage of the total population. A ratio of 1/12 was used. The second

ratio assumes hunters harvest a certain percentage of the population each year. A ratio of .20 (or 20%) was used. These ratios were derived from biologists at MassWildlife using various models and data analysis techniques. The average from these two estimates was used to generate density (deer/mi<sup>2</sup>) estimates for each year. Density estimates from the first 1-2 years a segment was hunted were not plotted because they were typically extremely high and made the graphs difficult to interpret.

There are, however, several potential problems with using these techniques to generate density estimates. The density estimate each year is derived from the annual harvest and implies that as the deer population increases, so will the yield. Therefore, trends in yield and population will be very similar since one is based on the other. Caution is warranted because yield may not always be strictly dependant on deer populations. Factors such as weather, hunter distribution, hunter effort, and deer behavior call all influence year to year harvest rates. An independent assessment of either the deer population or the harvest rate is necessary in order to independently assess both yield and deer populations. However, in the absence of these estimates, the only alternative is to use harvest rates to roughly estimate deer populations.

Trends for the Pelham block over the last 11 years have been highly variable. Hunter effort has been increasing slightly since 2001. Both yield and the deer population have fluctuated greatly. Trends in both yield and population were increasing from 1999 to 2002, yet both decreased during the 2003 season and increased slightly during 2004. With effort increasing slightly and both yield and population also increasing slightly, several scenarios for the deer population exist. If effort remains the same, then the population would likely decline. If the trend in yield continued then the population would begin to decline.



### Hardwick

Thirty-two deer were killed in 2 days during the Hardwick hunt (Table 4). This is a decline from the previous 2 years of hunting. Approximately 18% of the hunters in Hardwick successfully killed a deer. Hunter density was very close to the 11-year average with approximately 1 hunter for every 32 acres.

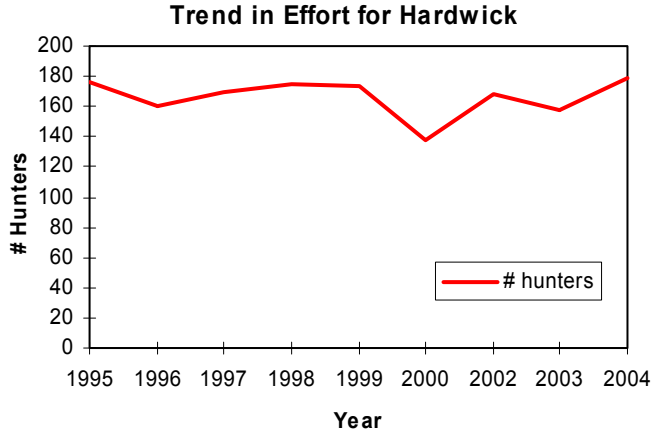
Table 4. Results of Quabbin Reservation controlled deer hunt, Hardwick Block, 1991-2004.

YEAR	# DEER KILLED	DEER/MI <sup>2A</sup>	DEER/HUNTER	% FEMALE	# ACRES/HUNTER
1993	150	16.9	.30	66.7	34
1994	65	7.3	.18	73.8	30
1995	37	4.2	.21	51.4	32
1996	26	2.9	.16	46.2	36
1997	57	6.4	.34	57.9	34
1998	25	2.8	.14	64.0	33
1999	23	2.6	.13	43.5	33
2000	30	3.4	.22	50.0	41
2001	N/A <sup>a</sup>	-	-	-	-
2002	45	5.1	.27	48.9	34
2003	57	6.4	.36	64.9	36
2004	32	3.6	.18	46.9	32
Total	547		Avg.=0.2	Avg.= 55.8	Avg.= 34.1

<sup>A</sup> Represents the number of deer killed per square mile; <sup>B</sup> Area was not hunted during that year.

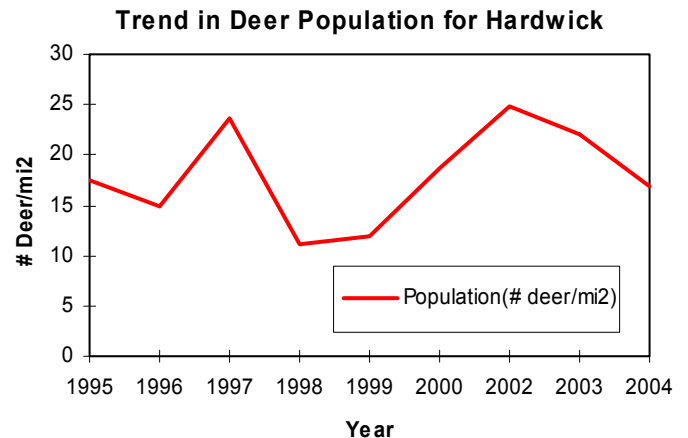
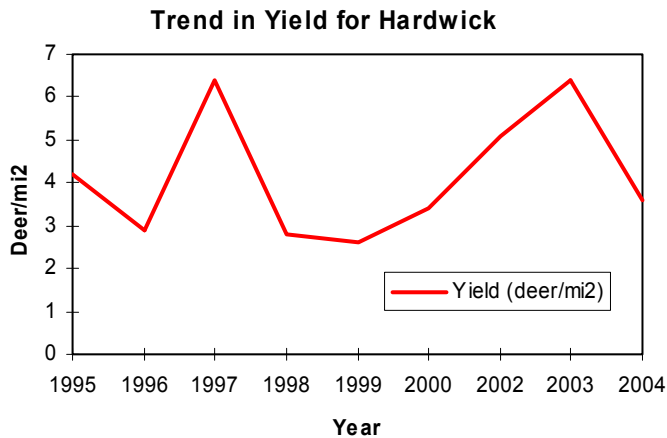


## 1. SUSTAINED YIELD



Trends in hunter effort for the Hardwick block have remained relatively stable over the last 3 years. The trend for yield increased steadily from 1999-2003 and then declined for 2004. The trend for population also increased steadily from 1999-2002, then has been declining since 2002. With a relatively stable trend in hunter effort and a declining trend in both yield and deer population, two scenarios may be possible. Since the trend in effort should continue, then

population may stabilize if the yield stabilizes. If the trend in yield continued, then the population would likely begin to increase.



### *Petersham*

Hunters killed 45 deer in 2 days of hunting in Petersham (Table 5). This represents the second highest 2-day deer kill since 1997. Around 14% of the hunters in Petersham killed a deer. Hunter density during 2004 was the same as 2003, which is higher than the 10 year average, and substantially higher than in 2001. In 2004, there was 1 hunter for every 26 acres.

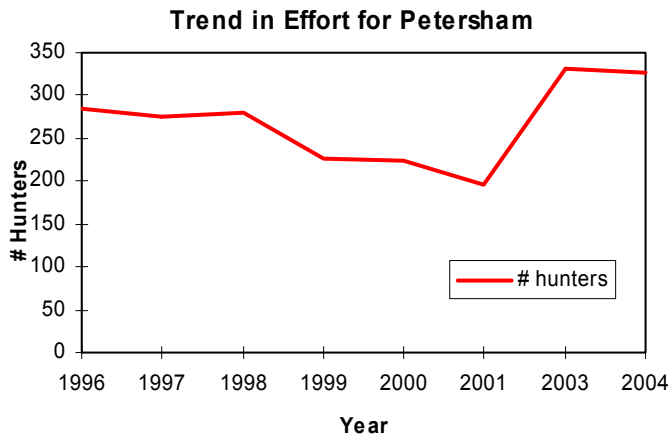
Table 5. Results of Quabbin Reservation controlled deer hunt, Petersham Block, 1991-2004.

YEAR	# DEER KILLED	DEER/MI <sup>2A</sup>	DEER/HUNTER	% FEMALE	# ACRES/HUNTER
1994	456	33.9	.54	60.5	30
1995	148	11.0	.26	75.7	31
1996	47	3.5	.17	70.2	30
1997	106	7.9	.38	64.2	31
1998	40	3.0	.14	52.5	31
1999	21	1.6	.09	23.8	38
2000	18	1.3	.08	33.3	39
2001	28	2.1	.14	50.0	44
2002	N/A	-	-	-	-
2003	212	15.8	.64	73.1	26
2004	45	3.3	.14	55.6	26
Total	1221		Avg.=0.3	Avg.= 55.9	Avg.= 32.6

<sup>A</sup> Represents the number of deer killed per square mile.

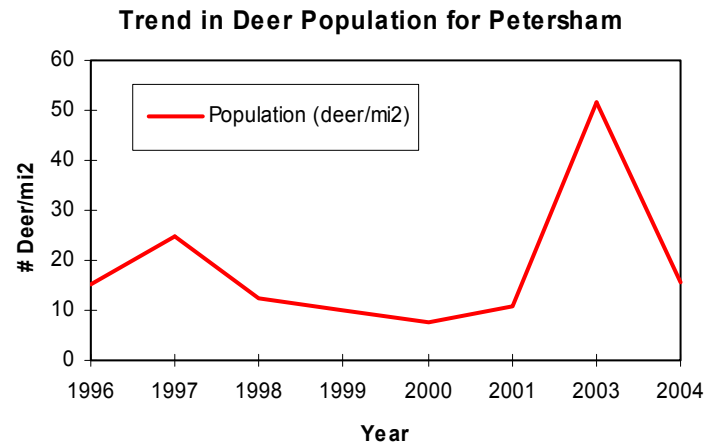
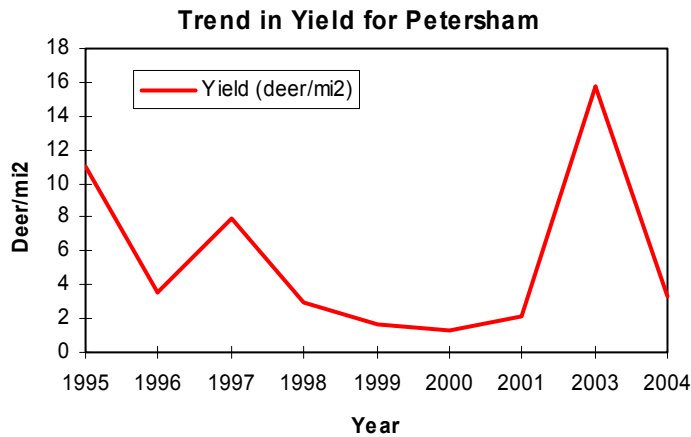
<sup>B</sup> Area was not hunted during that year.

## 1. SUSTAINED YIELD



Trends in hunter effort have shifted slightly during the last 5 years. From 1999 until 2001, there was a gradual decline in the number of hunters in the Petersham block. During 2003-2004, the number of hunters increased to its highest point since 1995. Trends in both yield and deer population showed a similar decline from 1998-2001. In 2003, harvest and the calculated population estimate increased tremendously. Both yield and population declined dramatically

during the 2004 hunt. With such large fluctuations in both yield and calculated populations levels, it is difficult to interpret the data. Several years of a specific trend are needed to determine where the population exists on the sustained yield curve.



### *Prescott*

Sixty deer were harvested in Prescott during 2004 (Table 6). Roughly 15% of the hunters successfully harvested a deer. Hunter density was slightly higher than the long-term average. There was around 1 hunter for every 31 acres of land.

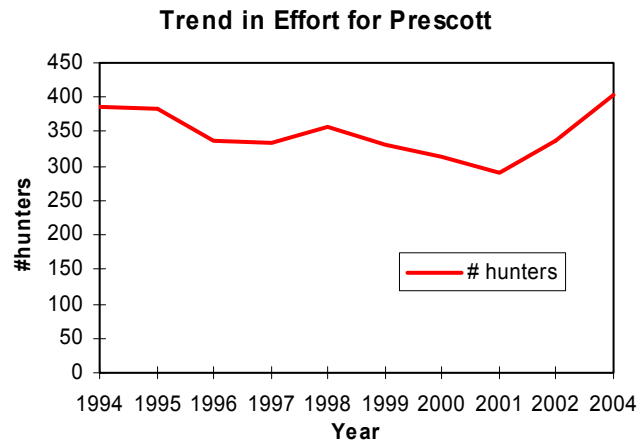
Table 6. Results of Quabbin Reservation controlled deer hunt, Prescott Block, 1991-2004.

YEAR	# DEER KILLED	DEER/MI <sup>2A</sup>	DEER/HUNTER	% FEMALE	# ACRES/HUNTER
1992	613	31.6	.58	53.5	37
1993	168	8.7	.17	61.3	38
1994	61	3.2	.16	60.7	32
1995	44	2.3	.12	52.3	32
1996	34	1.8	.10	50.0	37
1997	73	3.8	.22	68.5	37
1998	36	1.9	.10	52.8	35
1999	39	2.0	.12	43.6	38
2000	35	1.8	.11	45.7	39
2001	21	1.1	.07	57.1	43
2002	26	1.3	.08	53.8	37
2003	N/A	-	-	-	-
2004	60	3.1	.15	41.7	31
Total	1210		Avg.=0.2	Avg.= 54.6	Avg.= 36.8

<sup>A</sup> Represents the number of deer killed per square mile.

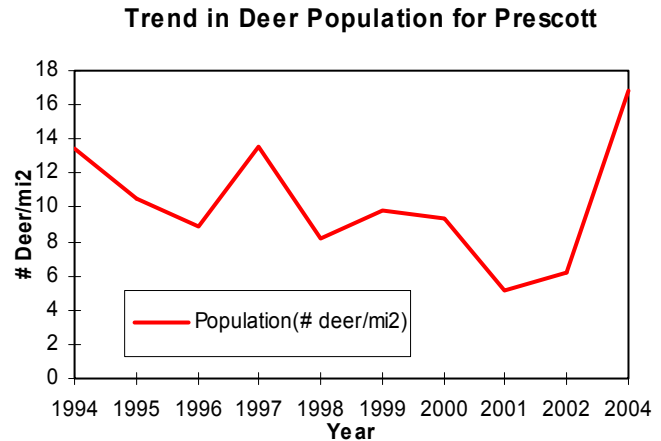
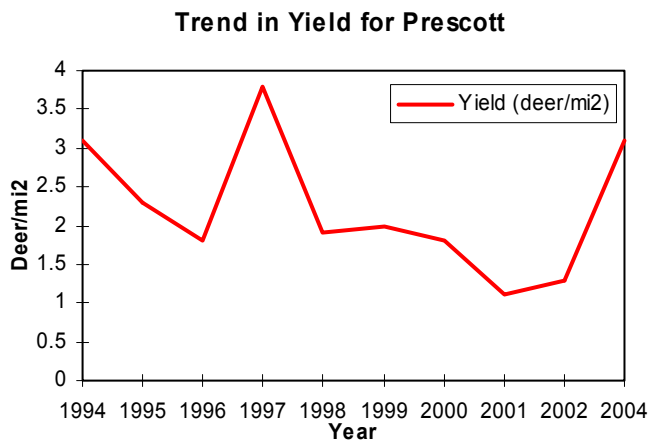
<sup>B</sup> Area was not hunted during that year.

## 1. SUSTAINED YIELD



The number of hunters has increased steadily since 2001. Trends for yield and deer population have also shown an increase since 2001. An increase in hunter effort, along with an increase in both yield and population would suggest that if effort continued, then the population would begin to decline. If the trend in yield continued, then the population is likely to decline. In the future, the trend in effort should stabilize, which may stabilize the yield

as well.



## **D. Program Costs**

The net cost for the Quabbin controlled hunt is calculated by subtracting the total cost accrued (overtime for Division personnel, equipment rentals, printing, etc.) from the revenue received from the \$5 application fees (Table 7).

Total cost for the hunt has decreased substantially since 1991. Revenue is dependent on the number of hunter applications, and it has fluctuated yearly. In order to conserve resources and time, no “sani-bags” were handed out to hunters during the 2004 hunt. Hunters were reminded at the orientation sessions to bring along their own towels or gloves to clean themselves after handling a deer.

Table 7. Costs and revenues (in dollars) of Quabbin Reservation controlled deer hunts, 1991-2004.

YEAR	TOTAL COST <sup>1</sup>	REVENUE <sup>2</sup>	NET COST
1991	109,680	37,220	72,460
1992	61,210	47,515	13,695
1993	36,621	35,260	1,361
1994	28,414	17,090	11,324
1995	23,679	24,220	(541)
1996	20,500	13,710	6,790
1997	17,343	8,950	8,393
1998	10,742	10,430	312
1999	15,192	7,610	7,582
2000	15,266	5,715	9,551
2001	11,357	5,285	6,072
2002	19,309	7,080	12,229
2003	15,910	8,320	7,590
2004	18,009	10,085	7,924

<sup>1</sup>includes overtime costs for hunt personnel, equipment rentals and purchases, and miscellaneous other expenses.

<sup>2</sup>derived from \$5 application fee.

### **III. 5-YEAR MANAGEMENT PLAN: PROGRAM REVIEW**

Deer densities on Quabbin Reservation have decreased dramatically since the hunts were initiated in 1991. In order to assess the impact of deer reductions, specific herd characteristics were summarized for each hunting block. These characteristics were used to assess the relative abundance of the deer herd in relation to the available habitat at Quabbin.

Population estimates are notoriously difficult to obtain, yet are often the most sought after deer statistic. Population reconstruction was used to generate a relative abundance estimate for deer in each hunting block up until 2001. While these estimates have several arbitrarily set parameters and are therefore not true population estimates, they do provide insight into the deer population trends in each hunting block.

The initiation of a rotation hunt in 2000 constituted a major change in the hunt program's structure. Instead of making year-to-year decisions, a long-term plan was mapped, and the general format of the hunts each year was predetermined. Overall, the 5-year plan (2000-2004) has worked well. Organizationally and functionally, it is easier to administer the hunts in this fashion. Further, hunters have responded well to the format, and seem more eager to hunt each year, particularly in blocks that have just "rested". However, characteristics of the current hunting scheme (i.e. rotation, 2-day hunts) acting independently or when combined with other factors (successive years of low harvests in a block) may lead to deer populations that are increasing instead of remaining relatively stable. The impacts of weather, length of hunt, and using a rotation schedule were examined to determine whether the program could be more effectively managed.

#### **A. Herd Characteristics**

##### ***Fawn Weights***

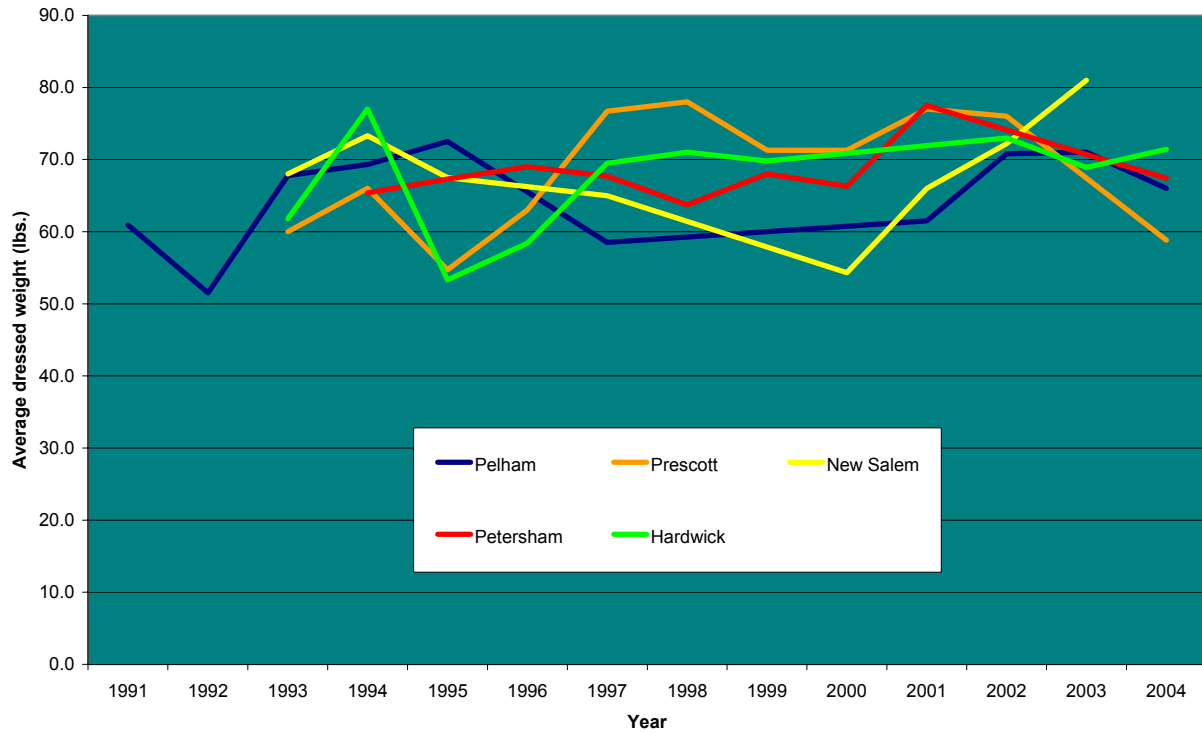
Average fawn weights can be used as an indicator of herd health. Because there is a limited supply of food and cover, deer populations at higher densities will experience more competition than populations at lower densities. Competition for food and cover can be reflected in fawn weights. A study in New York showed that fawns will weigh less at higher densities than lower densities when habitat is good. When male fawn weights for each hunting block are compared through time, there is a general trend of increasing size (Fig. 2). During the 2004 hunt, several hunting blocks showed a decrease in male fawn dressed weights. In particular, the Prescott and Petersham blocks both experienced noticeable declines in male fawn weights.

Female fawns showed a similar pattern to male fawns, however there was much more variation between years (Fig. 3). During 2004, female fawn dressed weights

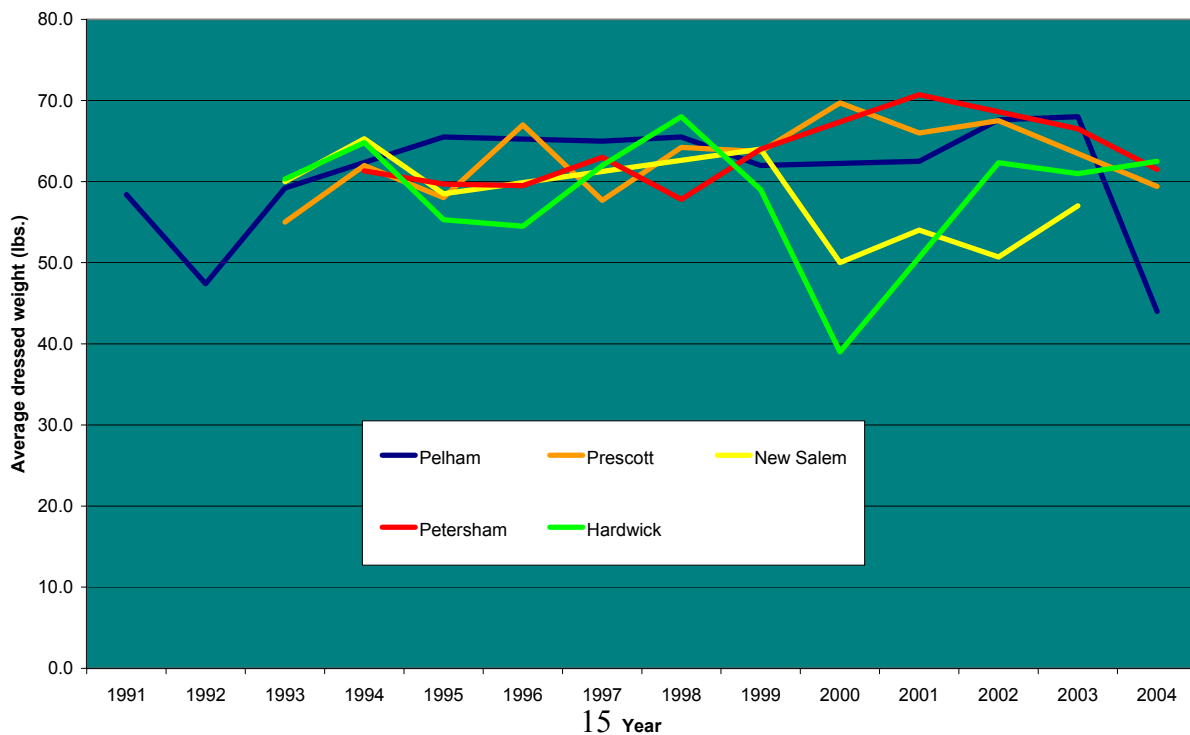


declined in Pelham, Petersham, and Prescott. However, Pelham and Petersham weights were based on only 1 and 2 samples, respectively.

**Figure 2. Average dressed male fawn weights (pounds), Quabbin Reservation, 1991-2004**



**Figure 3. Average dressed female fawn weights (pounds), Quabbin Reservation, 1991-2004**



When average male and female fawn weights were compared between years, the averages were significantly different.

### *Yearling Antler Beam Diameter*

Antler beam growth and size is dependant on a variety of factors including genetics of the animal, nutrition, and winter severity. While there is variation in antler growth between individuals, long-term averages can provide useful insight in herd characteristics. Yearling antler beam diameter (ABD) is collected and used to assess the relative abundance of the herd in relation to its habitat. When deer densities exceed the carrying capacity of the environment, yearling antler beam diameter will decrease. Conversely, when deer densities are below carrying capacity, average antler beam diameter will be larger. In general, when yearling antler beam diameter is 16mm or less, deer densities are exceeding carrying capacity. Antler beam diameters of 17-19mm indicate deer densities near carrying capacity, and antler beam diameters of 20mm or more indicate a density below carrying capacity.

Average antler beam diameters were calculated for each hunting block for each year and compared to antler beam diameters from deer taken outside Quabbin in zone 6 (Table 8). Antler beam diameters showed a large amount of variability within each block, however in most blocks there was a general increasing trend in diameter. When diameters for the first 3 years that Pelham, Prescott, and Hardwick were hunted were compared to the last 3 years those blocks were hunted, the average diameters were all greater during the last 3 years. This would indicate that the deer densities in those blocks have been reduced. Antler beam diameters in Petersham and New Salem have shown slightly decreasing trends. Antler beam diameters during the first few years these blocks were hunted were slightly larger than diameters from the last few years of hunting. This would suggest that deer densities in these areas are exceeding the carrying capacity of the habitat.

Antler beam diameters from deer within Quabbin were generally less than those from deer taken outside Quabbin in Zone 6. During 1991-1993, average ABD within Quabbin was always less than the average ABD in Zone 6. Beginning in 1994, ABD's from some Quabbin blocks begin to exceed the zone 6 average. However, in any given year ABD's from zone 6 deer exceeded ABD's from at least 2 Quabbin blocks (except 2000 when all of Quabbin's blocks exceeded zone 6).

Table 8. Summary of average yearling antler beam diameters (n sample size) for Quabbin Reservation and the surrounding Deer Management Zone 6, 1991-2004.

Year	Block					Average	Zone 6
	Pelham	Prescott	Hardwick	Petersham	New Salem		
1991	16.2 (33)	- <sup>a</sup>	-	-	-	16.2	18.1 (67)
1992	15.5 (70)	-	-	-	-	15.5	17.6 (70)
1993	16.3 (8)	15.4 (8)	16.8 (13)	-	13 (9)	15.4	16.2 (27)
1994	17.5 (6)	16.5 (10)	20.5 (2)	17.1 (23)	18.3 (3)	18.0	16.8 (23)
1995	19.3 (6)	16 (7)	16.5 (6)	17.2 (6)	17.3 (3)	17.3	18.3 (45)
1996	18.5 (2)	15 (6)	17.8 (4)	17.8 (6)	14.5 (2)	16.7	16.4 (27)
1997	17.7 (6)	15 (7)	16.4 (10)	17.3 (8)	18 (3)	16.9	17.8 (21)
1998	15.7 (3)	22.5 (6)	18 (5)	13.3 (3)	-	17.4	16.9 (29)
1999	11.5 (2)	18.6 (11)	17.3 (3)	18.8 (5)	16.3 (3)	16.5	16.9 (16)
2000	-	21.5 (8)	20.3 (6)	19 (2)	19 (5)	20.0	18.4 (29)
2001	15.3 (4)	20.4 (5)	-	13.7 (3)	16 (2)	16.4	17.9 (31)
2002	20.4 (7)	19.8 (5)	18.5 (6)	-	16 (1)	18.7	20.6 (21)
2003	17.2 (6)	-	17 (3)	15.2 (9)	16.3 (3)	16.4	20.3 (14)
2004	19.5 (2)	17.4 (4)	20.3 (4)	17.8 (5)	-	18.8	-
Average	17.0	18.0	18.1	16.7	16.5		17.8

<sup>a</sup> Either block was not hunted that year, or no data was collected

### *Population Estimation*

Determining a precise density estimate of any wild species is difficult, and white-tailed deer are no exception. Population estimates can be achieved through a variety of techniques, and each has its own set of inherent difficulties. Given limited resources and personnel, deer populations on Quabbin Reservation were not assessed through direct estimates (i.e. distance sampling) or censuses (i.e. spotlighting). However, because all harvested deer were checked by Division personnel, accurate and detailed data was collected on each deer, including age, sex, weight, antler beam diameter, etc. These data were used in a technique called population reconstruction. Population reconstruction tracks specific cohorts through time until they are harvested and removed from the population. By working backwards through time, populations could be reconstructed. For example, in any given year (X), a certain number of fawns, yearling, and adults were harvested. A 3.5 year old deer harvested in year X would have been 2.5 years old in year X-1, 1.5 years old in year X-2, and a fawn in year X-3.

This individual deer could be placed back in the population to achieve a minimum population estimate for each year.

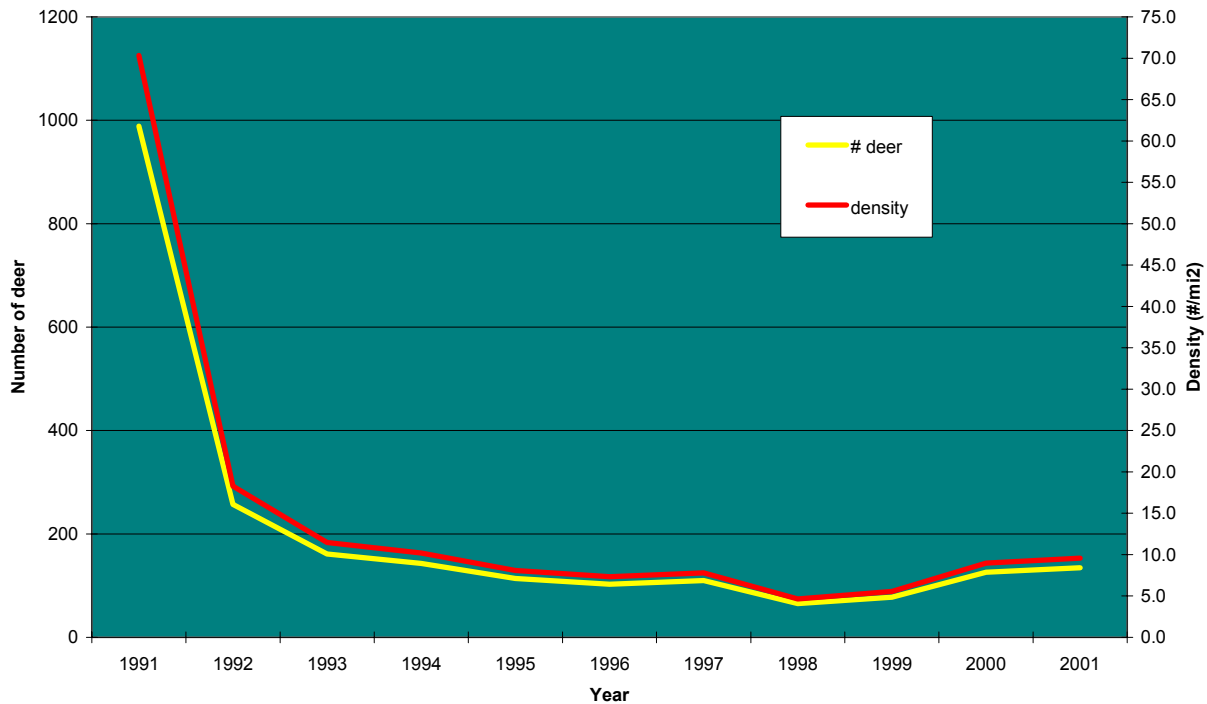
Populations for each hunting block were reconstructed using this technique. In most cases, the population could only be reconstructed up until 2001. Populations in subsequent years could not be determined because some deer would still be at large in the population. In order to estimate populations beyond the known minimum number of deer certain parameters had to be assumed. Crippling losses (those deer killed by hunting but not recovered) of 10% were assumed for all ages and sexes. This estimate may be low, but was used for several reasons. First, because Quabbin is a controlled hunt, there are resources available to the hunter to help find and recover deer including ATV's, boats, and 4-wheel drive vehicles. Secondly, results from published studies of radio-collared deer have indicated wounding losses from shotguns of 10% and 14% for females and males, respectively.

The second parameter that was arbitrarily set was an estimate of natural mortality. Not all deer were accounted for through harvesting, so in order to calculate absolute population estimates a lifetime recovery rate had to be assumed. Lifetime recovery rates of 80% were assumed for males and females. Again, these numbers were based on deer research from various parts of the country where annual survival rates ranged from 65-80%. In addition, there was little evidence to suggest that winter mortality had a large impact on Quabbin populations and deer/vehicle collisions were probably minimal for deer residing in Quabbin Reservation.

#### 1. Pelham

The Pelham deer population was reconstructed from 1991-2001 using harvest data and the arbitrarily set parameters (Fig. 4). Because the crippling loss and lifetime recovery rates were set arbitrarily, the resulting population estimate is really an index of the population over time. There was a substantial reduction in population during the first 2 years of hunting. Since 1995, the population has remained relatively stable.

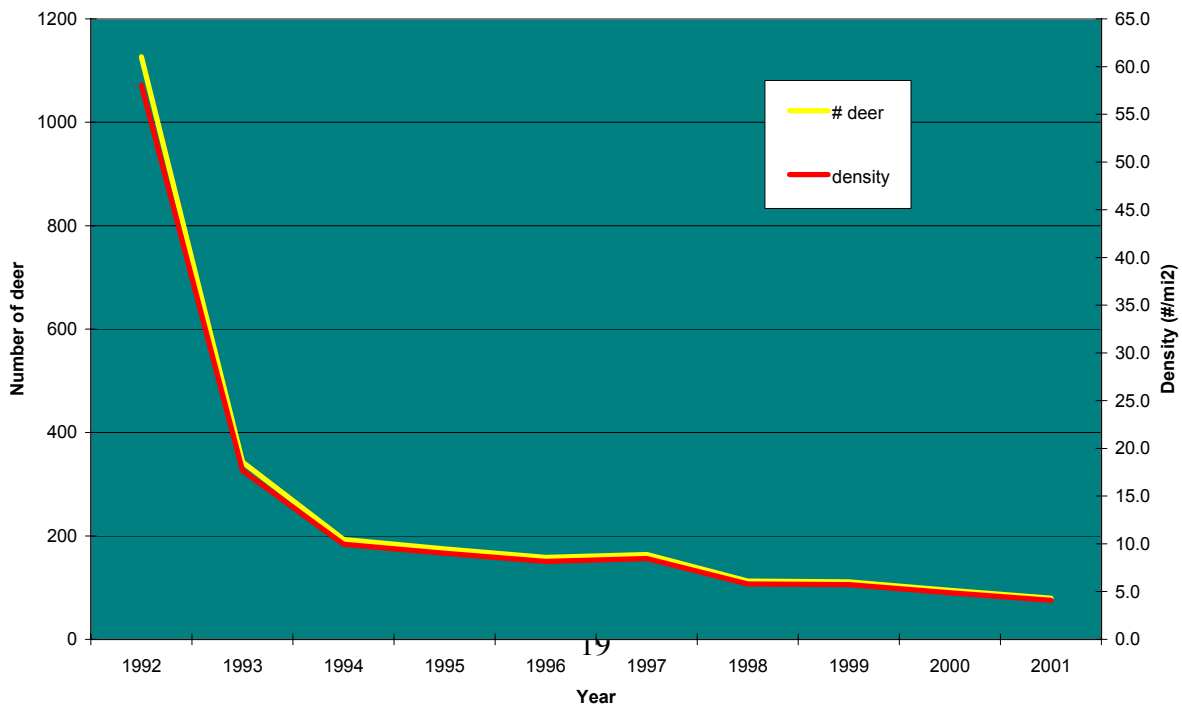
**Figure 4. Reconstructed pre-hunt deer populations showing total number of deer and density prior to each year's hunt, Pelham 1991-2001**



## 2. Prescott

The Prescott deer herd was reconstructed from 1992-2001 (Fig. 5). Like Pelham, the deer herd on Prescott was substantially reduced during the first 2-3 years of hunting. Since 1997, the reconstructed population showed a gradually declining trend.

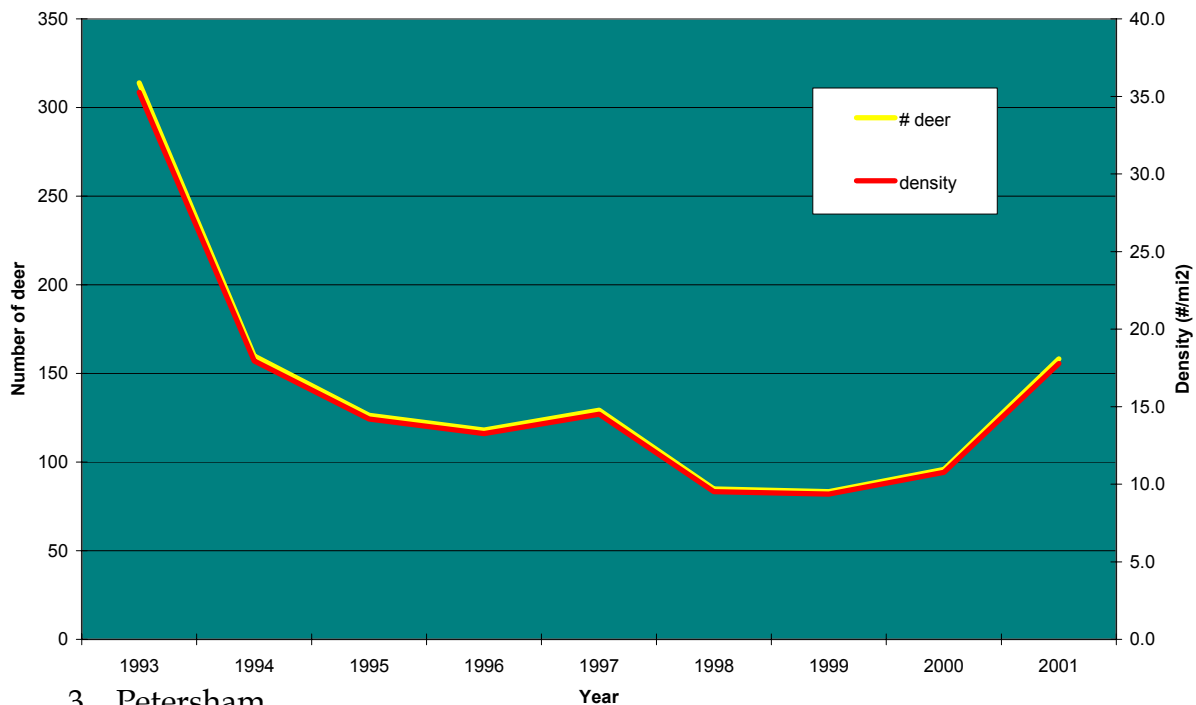
**Figure 5. Reconstructed pre-hunt deer populations showing total number of deer and density prior to each year's hunt, Prescott 1992-2001**



### 3. Hardwick

Deer populations in the Hardwick block were reconstructed from 1993-2001 (Fig. 6). While deer populations declined substantially during the first 2 years of hunting, Hardwick did not experience the same magnitude of decline as Pelham or Prescott. Deer densities during 2000-2001 were roughly 50% of densities during 1993. In Pelham and Prescott, densities during 2000-2001 were only 9-15% of densities during the first year of hunting.

**Figure 6. Reconstructed pre-hunt deer populations showing total number of deer and density prior to each year's hunt, Hardwick 1993-2001**

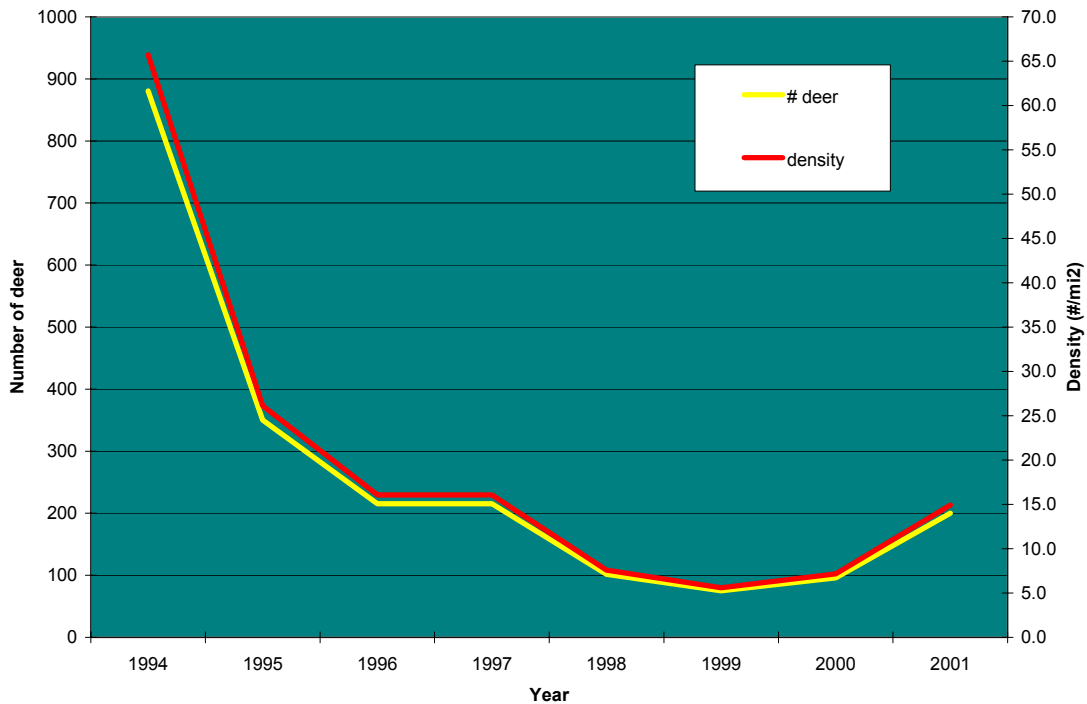


### 3. Petersham

Deer densities in Petersham were reconstructed from 1994-2001 (Fig. 7). A similar pattern was evident in the Petersham block, however while most blocks took 1-2 years to complete the initial herd reduction, reducing the deer herd in Petersham took several years (1994-1997). The deer population in Petersham reached a low in 1999, but from 1999-2001 showed an increasing trend. While the year 2003 could not be reconstructed, it is interesting to note that in 2003 hunters harvested 212 deer.



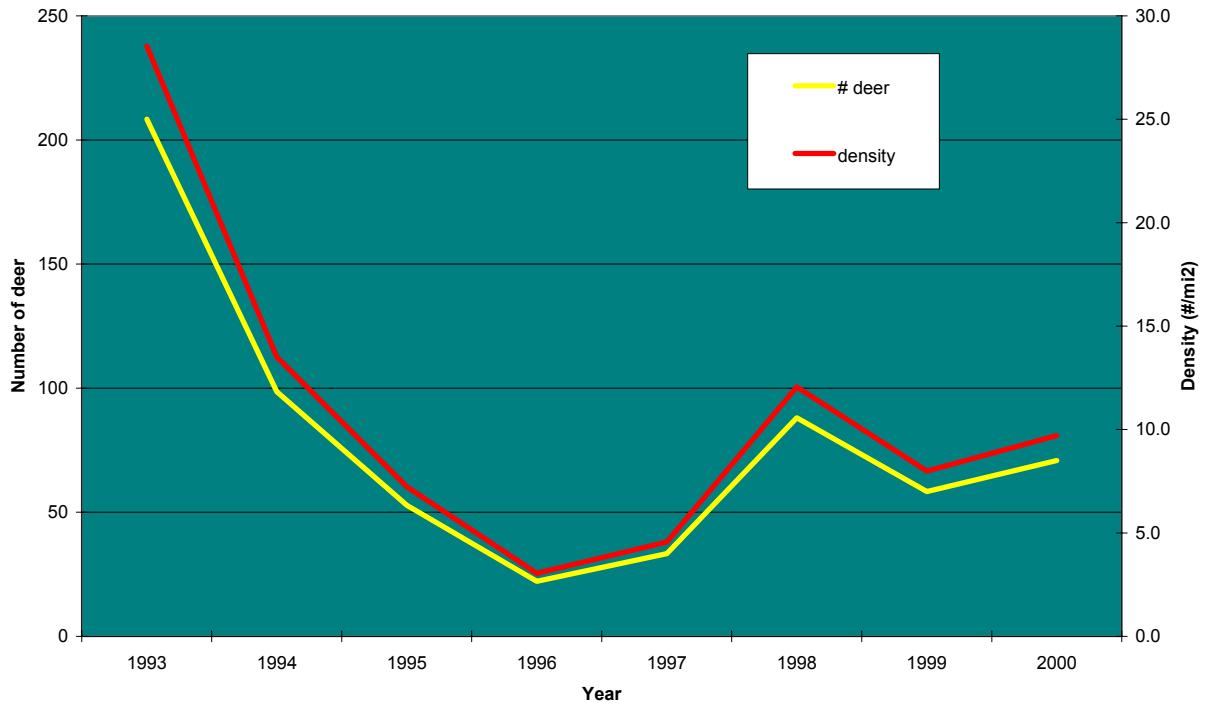
**Figure 7. Reconstructed pre-hunt deer populations showing total number of deer and density prior to each year's hunt, Petersham 1994-2001**



#### 4. New Salem

Deer populations in New Salem were reconstructed from 1993-2000. Because New Salem was not hunted in 2004, the 2001 data could not be reconstructed. The reconstructed population in New Salem indicates several things. First, the data indicate that initial deer densities in New Salem were much less than in other hunting blocks. It also indicates that after reaching a low point in 1996, the population showed a generally increasing trend from 1997-2000. Additional data should prove useful in determining where the trend will go.

**Figure 8. Reconstructed pre-hunt deer populations showing total number of deer and density prior to each year's hunt, New Salem 1993-2000**



## **B. Hunt Characteristics**

### *Effect of Weather on Harvest*

Controlled hunts at Quabbin are typically short. Outside of the initial hunting effort from 1991-1994, when multiple hunting segments per block per year were used, most hunting takes place in one 2 or 3 day segment per block. Because the hunting effort each year is brief, it is possible that weather may influence harvest in any given year. The state-wide deer season typically lasts 12 days, which would lessen the impact of weather on any given 2 or 3 day segment.

High and low temperatures and the presence or absence of snow cover would likely be the most important factors influencing deer harvest rates in any given year. High and low temperatures, precipitation, snowfall, and the presence or absence of snow on the ground were determined for each hunting day at Quabbin beginning in 1993 (appendix A). The first year a segment was hunted was excluded from analysis because harvests were high, regardless of weather conditions. Multiple linear regression was used to determine if temperature or the presence of snow had a statistically significant impact on deer harvest for that day. Neither high temperature ( $t=-1.72$ ,  $p=.088$ ), low temperature ( $t=-.882$ ,  $p=.379$ ), or snow cover ( $t=1.56$ ,  $p=.122$ ) had any statistically significant effect on deer harvest.

The average low temperature (1991-2004) during the Quabbin hunts was 28° F, and the average high temperature was 43° F. Snow cover was only present for 36 hunting days, and snow cover was absent the remaining 123 hunting days.

### *Length of Hunt vs. Harvest*

Early Quabbin hunts often consisted of multiple hunting segments of several days in each segment. This hunting scheme lasted for 2-3 years after a block was initially hunted. Following this intensive hunting effort, seasons were shortened to 2-3 days per block per year. From 1993-1998, several hunting blocks at Quabbin were extended to 3 days. Daily harvest was calculated for blocks that were hunted 3 days during 1993-1998 (Table 9) to determine if extending a hunt by an additional day had any impact on total harvest for that block. Harvests from the first 2 years a block was hunted were excluded from analysis.

Table 9. Daily harvests and percent of total (in parentheses) for blocks hunted 3 days, Quabbin Reservation, 1993-1998.

Year		Day 1	Day 2	Day 3	Total
1993					
	Pelham	38 (65.5)	14 (24.1)	6 (10.3)	58
1994					
	Pelham	34 (68.0)	13 (26.0)	3 (6.0)	50
	Prescott	44 (72.1)	11 (18.0)	6 (9.8)	61
1995					
	Hardwick	23 (62.2)	9 (24.3)	5 (13.5)	37
	New Salem	18 (66.7)	6 (22.2)	3 (11.1)	27
1996					
	Petersham	35 (74.5)	9 (19.1)	3 (6.4)	47
1998					
	Pelham	17 (77.3)	3 (13.6)	2 (9.1)	22
	Prescott	24 (66.7)	11 (30.6)	1 (2.8)	36
	Petersham	34 (85.0)	4 (10.0)	2 (5.0)	40
	Hardwick	15 (60.0)	4 (16.0)	6 (24.0)	25
Average		(69.8)	(20.4)	(9.8)	

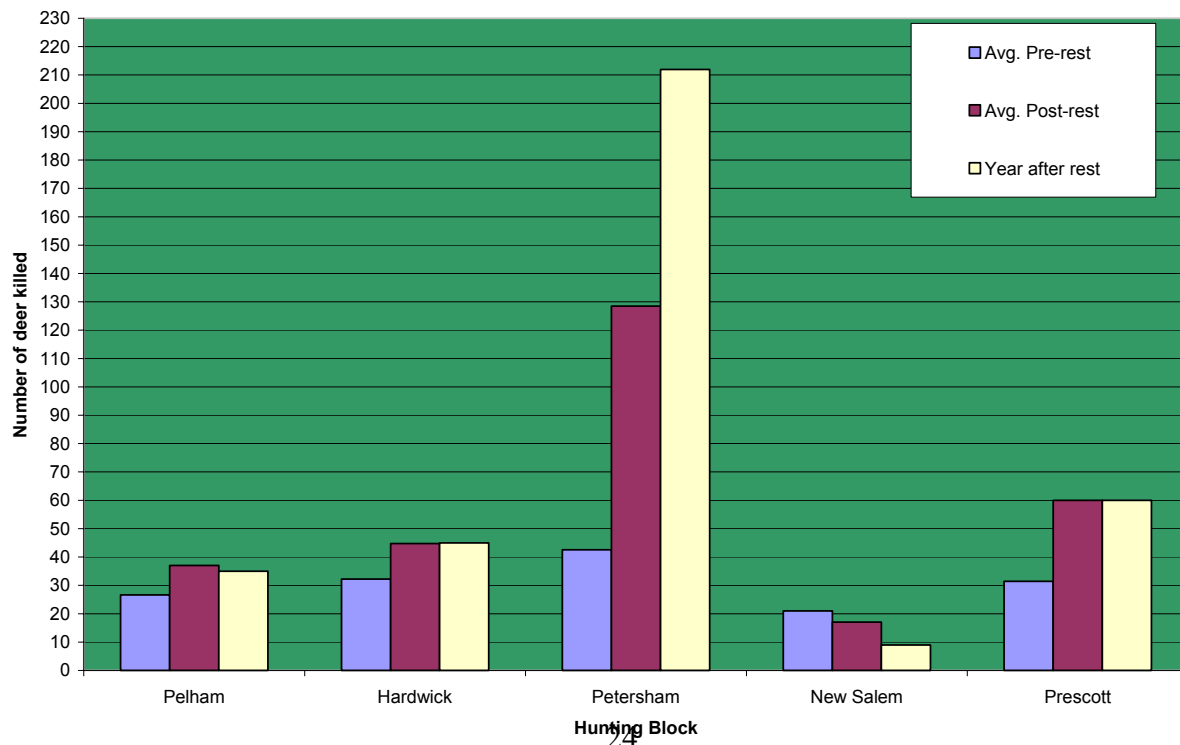
Deer harvests on the third day of a hunting season ranged from 1 to 6 deer. On average, the third day of hunting only contributed 9.8% of the total kill (range 2.8-24.0%). The first day of a season accounted for an average of almost 70% of the harvest for that hunting block. Extending a season beyond 2 days does not add significantly to the total harvest.

## *Effect of Rotation on Harvest*

Beginning in 2000, the 5 Quabbin hunting blocks were placed on a rotation schedule. Every year, a block was removed from the hunting pool. Any particular block was hunted 4 out of 5 years. Initiating the rotation schedule allowed deer populations within any particular hunting block to be free from hunting mortality for 2 reproductive seasons. For example, if a block was hunted in 1999, fawns would be born the following summer (2000 – season 1). The block was scheduled to not be hunted during 2000, so no hunting mortality would occur. Fawns would again be born the next summer (2001 – season 2). Hunting would take place in the fall of 2001, and there would be an additional 2 cohorts of deer in the population.

Harvests were calculated for each hunting block before and after a block was removed from hunting (“rested”) (Fig. 4). The average harvest for the 5 years prior to a rest year was compared to the harvest immediately following a rest year, and the average harvests following that year. In all hunting blocks except New Salem, average harvests after the rest year and immediately following the rest year were all larger than the average harvests leading up to a rest year. In the Petersham block, the difference in harvests between pre- and post-rest was dramatic. While the New Salem block showed a decrease in harvest before and after a rest year, the data used in the calculations was not from the regular 5-year rotation. In the regular rotation, New Salem was rested in 2004, and data was not available to make comparisons. As a result of other circumstances, New Salem was not hunted during 1998, so this year was used as the rest year.

**Figure 9. Five-year average harvests before a block was “rested”, harvest immediately following the “rest” year, and average harvests following the “rest” year**



## **IV. 5-Year Management Plan: 2005-2009**

### **A. Recommended Action**

#### **1. Institute a modified rotation**

Yearly harvests can be influenced by a variety of things including weather, hunter density, hunter distribution, hunting restrictions, deer density, and deer distribution. Results from the last 5 years of hunting strongly indicate that harvests increase in the years following a rest year. This increased harvest is in part a result of a larger deer population that was produced during 2 successive breeding seasons. However, in certain situations (i.e. Petersham in 2003), a period of relatively low harvests can precede a scheduled “rest” year. The combination of low harvests, which may have resulted from either poor weather during the short 2-day hunts, poor hunter distribution, or a variety or combination of other factors, and a scheduled rest year can lead to a growing deer population. This situation occurred during 2003 in Petersham. Petersham experienced a series of relatively low harvests prior to 2002. In 2002, Petersham was not hunted, allowing the deer population to continue to grow. In 2003, hunting conditions were ideal, and the harvest was roughly 8 times larger than 2001 and 2000. Poor hunting conditions in 2003 might have resulted in a much lower harvest.

In order to ensure deer populations remain at densities that are compatible with forest management goals, it may be necessary to increase hunting pressure for a short period of time. In Petersham during 2003, it would have been helpful to allow a second 2-day hunt to further reduce the deer population, particularly when there were ideal hunting conditions. Therefore, the 5-year plan follows the same rotation schedule as in the previous 5 years. However, now there is an option to allow the Division to incorporate a second 2-day hunt in blocks that have just re-entered the hunting pool after a year off (Table 10). This second hunting segment would take place when conditions in a particular block indicate that the deer herd may have been growing over a period of years. The second hunting segment would be temporally separated from the first hunting segment (i.e. the first hunt would take place on the first 2 days of the hunting season, and the second segment would take place on the last 2 days of the hunting season). This second hunting segment may not be necessary in each block, depending on the harvests and hunting conditions in previous years.

If instituted, the second hunt would take place during the regular shotgun season, or be delayed until the start of the muzzleloader season. Waiting until the muzzleloader season would improve the chances of snow cover. In addition, having a muzzleloader season at Quabbin may attract a new group of hunters that has previously not participated in the hunts. While this second hunting segment will remain an option, it will not be used during the 2005 hunt.

Table 10. Hunting block rotation on Quabbin Reservation, 2005-2009.

YEAR	AREAS HUNTED				
2005	<del>Pelham</del>	Hardwick	Petersham	Prescott	New Salem -2 seg <sup>a</sup> .
2006	Pelham – 2 seg.	<del>Hardwick</del>	Petersham	Prescott	New Salem
2007	Pelham	Hardwick – 2 seg.	<del>Petersham</del>	Prescott	New Salem
2008	Pelham	Hardwick	Petersham – 2 seg.	<del>Prescott</del>	New Salem
2009	Pelham	Hardwick	Petersham	Prescott – 2 seg.	<del>New Salem</del>

 Indicates the block not being hunted that year.

<sup>a</sup> Block could be hunted for two 2-day segments

## 2. Maintain adequate hunter densities

Maintaining optimum hunter densities is an important component of the Quabbin hunts, especially since hunts are short in duration. An original goal of 1 hunter per 30-35 acres was established in 1991. Since then, hunter densities have fluctuated, and in some years densities were substantially lower. The fluctuation in hunter density was a result of fewer hunter applications, so adjustments had to be made when assigning hunters to each block.

Set goals of no less than 1 hunter per 30 acres should be maintained for all hunting blocks. Hunter densities below this goal should be avoided. Maintaining hunter densities at this level will allow for an adequate number of hunters to be distributed across the hunting block, ample hunting pressure, and a more direct interpretation of harvest results.

## 3. Develop an independent assessment of deer harvest rates or relative abundance

Determining the relative abundance of deer populations at Quabbin strictly from harvest data is a difficult task. The inherent assumption is that as deer densities increase or decrease then harvest rates will also go up or down. However, because Quabbin hunts are very short in duration and influenced by a variety of factors, this assumption may not be valid. It is highly unlikely that deer harvests in Petersham in the years prior to 2003 were indicative of a low density deer herd. In reality, the deer herd in Petersham was most likely growing over a period of years, but the harvest did not reflect this trend for a number of reasons (low hunter density, poor hunter distribution, etc.). In order to more accurately assess the relative abundance of deer in any particular hunting block, an independent assessment of the herd is critical.



This independent assessment can be accomplished through a variety of different techniques that vary in the amount of resources or personnel needed to accomplish them. Some examples include:

1. Spotlight surveys
  - a. Conducted primarily at night along pre-determined routes to document the number of deer seen
  - b. Provides an estimate of relative abundance
  - c. Can be used to determine doe/fawn ratios
2. Capture and marking
  - a. A known sample of deer are captured and marked (ear-tagged) and the number of marked deer harvested can be used to generate population estimates and harvest rates
3. Distance sampling
  - a. Technique that was used in the Quabbin Park study
  - b. Provides density estimates
  - c. Very labor intensive
4. Browse Surveys
  - a. Amount of browse can be related to the relative abundance of deer
  - b. Key indicator plant species could also be monitored
  - c. Caution must be used to separate deer from moose browse

Efforts will be made to institute at least one of the techniques to provide additional data on the Quabbin deer herd. This independent assessment of the deer herd will be helpful when examining harvest data and making specific management recommendations.

#### 5. Control hunter distribution

Effectively distributing hunters throughout any of the hunting blocks has continued to be a challenge. Some blocks (Prescott and Petersham) are extremely large, and it is easy to have hunters clump in certain areas, while other large tracts of land remain essentially unexplored. In order to address this concern, both Prescott and Petersham could be divided into 2 hunting zones. Hunters would not be restricted from entering the other zone in a block, but would be strongly encouraged to remain and hunt in their assigned block.

During the 2005 hunt, Petersham will be divided into a north and south zone (Fig. 11). On the morning of the hunt, hunters assigned to the northern zone will enter through Gate 31. Hunters in the south zone will enter through the usual Gate 40. At the end of the day, all hunters must exit through Gate 40.

While the Prescott block is large enough to be divided into an east and west zone (Fig. 10), no division will take place during the 2005 hunt. In the future, the Prescott block may be divided into zones. Each zone is approximately the same size. When the

division takes place, hunters would enter the east zone through Gate 20. Hunters assigned to the west zone would enter through the traditional Gate 17. At the end of the day, all hunters must exit through Gate 17 where the deer check station and check shack are located. Hunters would not be restricted to their assigned zone; however they would be strongly encouraged to remain in their zones for the duration of the hunt. In addition, signs would be posted at transition sites to let hunters know they are leaving their zone and entering the other zone.

Using a second access gate in the morning of each hunt will require a Division staff person to be located at those gates (20 and 31) to collect access permits. However, that person will only need to stay a set amount of time (i.e. 3 hours). After that time period, the gate can be closed, and all subsequent hunters can be redirected to the main access gate (i.e. 17 or 40). While there may be a few hunters who may end entering into the wrong zone because their gate was closed, a majority of hunters should make it into the correct area. Neither Hardwick nor New Salem is large enough to warrant being subdivided into zones. Hunter distribution in these blocks seems adequate.

#### 6. Design and administer a hunter survey

Surveys of Quabbin hunters were conducted in 1995 and 1996. While these surveys provided useful information, they only targeted hunters attending orientation sessions. Because considerable changes have been made to the Quabbin hunts (rotation, time of hunts, etc.) in the last 10 years, it would be helpful to administer a new survey during 2005.

The new survey would target all hunters chosen for the 2005 hunt, including those that don't need to attend orientations. Since hunters receive several mailing from the Division, there is ample opportunity to include a short survey with their paperwork. Results of the survey will be used to fine tune how the Quabbin hunts are administered and address potential concerns the hunters may have.

#### 7. Initiate efforts to sample yearly acorn production

In the past, research studies have documented yearly acorn production around Quabbin Reservation. These studies have not been conducted for several years. Because such large areas of Quabbin are covered in productive oak forests, it is important to try and assess how yearly acorn production affects both deer biology and forest regeneration. Therefore, efforts will be made to quantitatively assess acorn crops each year at Quabbin. Hopefully, this information can be used in combination with other data already being collected.

## **B. Other Hunt Changes**

For the most part, the Quabbin controlled hunts will be managed much like they have been in the past 5 years. Hunters will be allowed to apply in groups of up to 6 people. Each hunter's license number on the application will be included in the random drawing. Like last year, the Division is allowing hunters to skip the orientation if they have been to one in the last 6 years.

Antlerless deer killed at Quabbin will still be considered "bonus" and not count towards a hunter's statewide bag limit. Efforts were made to change current regulations that restrict Quabbin hunters to harvesting only 2 deer. Statewide regulations, outside Quabbin, allow hunters to harvest as many deer as their permits allow. Currently, Quabbin hunters are restricted to harvesting only 2 deer, regardless of the number or types of permits they possess. Conversations with staff at MassWildlife indicated that the regulations would remain the same.

Regular operational components will not change. Portable sanitary facilities will be placed throughout the hunt areas. In addition, the 4:00 p.m. checkout time will remain in effect, and all hunters must check in and out of the hunt each day. Biological data will continue to be collected on all harvested deer.

The Quabbin deerhunt application will again be made available on the Division website for downloading and printing. This year the application will ask hunters about their FID card. Expired cards continue to be a problem at the Quabbin hunt. Hopefully, asking for FID information on the application will remind hunters to renew their card if it has expired.

The Division will again allow 2-day vehicle scouting for all hunting blocks this fall. Last year, the Division allowed all hunters the opportunity to drive into their hunting block for 2 days of scouting. These 2-day vehicle scouting opportunities will hopefully improve hunter distribution and hunter success. Finally, the Division will try to continue with its check-in/check-out procedure. The check-in procedure uses perforated cards with unique numbers. This allows hunters to simply hand a number to the check station attendant and then leave, without having to wait for a card to be returned.

Applications for the 2004 Quabbin hunt included a section that asked hunters to indicate their willingness to hunt an additional segment. This feature allowed the Division to identify hunters who were willing and able to be placed in a second hunting segment in the event that there were too few applicants to fill a segment during the initial random drawing. While the Division did not need to use this option during the 2004 hunt, this feature will remain on the 2005 application in case hunter interest declines.

### **C. Quabbin Park**

The Division continues to have internal discussions regarding the management of Quabbin Park. The 2003 population study report indicated an extremely high deer density within the park. The large number of deer within the Park has a potentially large impact on a variety of things. Internal discussions have touched on a diversity of topics including:

1. The large deer herd and the associated abundance of deer ticks and rate of Lyme disease
2. The effects of the deer herd on regeneration on Park lands both on and off watershed
3. The potential of the deer herd within the Park to serve as a source population for other areas of the Reservation
4. A variety of public opinions regarding the deer herd within the Park and how they should be managed (if at all).

Discussions will continue, and the Division will continue to explore management options, including the feasibility of initiating a public hunt within the Park to reduce deer densities. Because of the sensitive nature of the Park, any management decisions will be presented separately in an independent report.

### **D. Paraplegic Hunting**

Quabbin Reservation has hosted a paraplegic hunt for the last 5 years. This hunt is held in October each year outside the regular deer hunting season. Typically 4-6 hunters participate in the hunt, and approximately 6 deer have been harvested over the last 5 years. Hunting has taken place in a variety of locations around the administration building with Quabbin Park. Quabbin Reservation will continue to host the paraplegic hunt each year, with the location of the hunt being determined by late summer.